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## SNARE HUNTING AMONG BAKA HUNTER-GATHERERS: IMPLICATIONS FOR SUSTAINABLE WILDLIFE MANAGEMENT

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**ABSTRACT** Diversity in hunting methods has been reported among the Mbuti net hunters in Ituri in northeastern Democratic Republic of the Congo, among the Baka hunters in southeastern Cameroon, who currently practice snare hunting as their principal method, and among other hunter-gatherers in central African forests. Although forest duikers are the main targets of all of these hunters, different species of duikers are captured by different methods. Blue duikers (*Philantomba monticola*) weighing about 4–5 kg comprise the majority of the Mbuti's net-hunting harvests, whereas red duikers (in particular, *Cephalophus callipygus* and *C. dorsalis*) weighing about 15–20 kg are the major catch in Baka snare hunting. The density of duikers in each area is reflected in the rate of captures: the density of blue duikers is higher in the forests used by Mbuti net hunters, and red duikers are more abundant in the Baka area. Thus, it is likely that the relative abundance of each species is one of the major contributors to the selection of an efficient hunting method. Indeed, non-traditional methods may be selected as a result of adaptation to ecological conditions, the availability of hunting tools, and the changing role of hunting in the livelihoods of hunters. An understanding of the context in which hunting methods are selected is needed to design an effective wildlife management plan that is acceptable to the local people who depend on hunting for their livelihood.

**Key Words:** African Pygmy; Hunting method; Blue duiker; Red duiker; Southeastern Cameroon; Wildlife management.

### INTRODUCTION

Central African forest hunter-gatherers, or Pygmies, are distributed throughout the tropical rainforests in and around the Congo Basin (Fig. 1). Hewlett (1996) identified four general characteristics of these groups: (1) they spend several months each year hunting and gathering in the forest; (2) they strongly identify with and prefer forest life; (3) they maintain many-stranded social and economic relations with neighboring farming populations; and (4) they practice important ritual activities associated with elephant hunting.

However, as Hewlett (1996) argued, considerable diversity has been recorded among the Pygmies (also see Bahuchet, 2014), including diversity with regard to hunting methods. Among the well-documented four groups, the Mbuti of the Ituri Rainforest in the northeastern Democratic Republic of the Congo (DRC) practice net hunting (Harako, 1976; Tanno, 1976; Ichikawa, 1983), whereas the Efe, who also live in the Ituri Rainforest, never practice net hunting, preferring bows and arrows (Harako, 1976; Terashima, 1983). Currently, the Aka and Baka in the northwestern Congo Basin both practice snare hunting (Kitanishi, 1995; Yasuoka, 2006a). However, many Aka predominantly use nets for hunting

(Bahuchet, 1985; Takeuchi, 1995; Noss, 2000; Lupo & Schmitt, 2005), whereas the Baka do not use this approach, but engage in collective spear hunting (Bahuchet, 1993; Yasuoka, 2013).

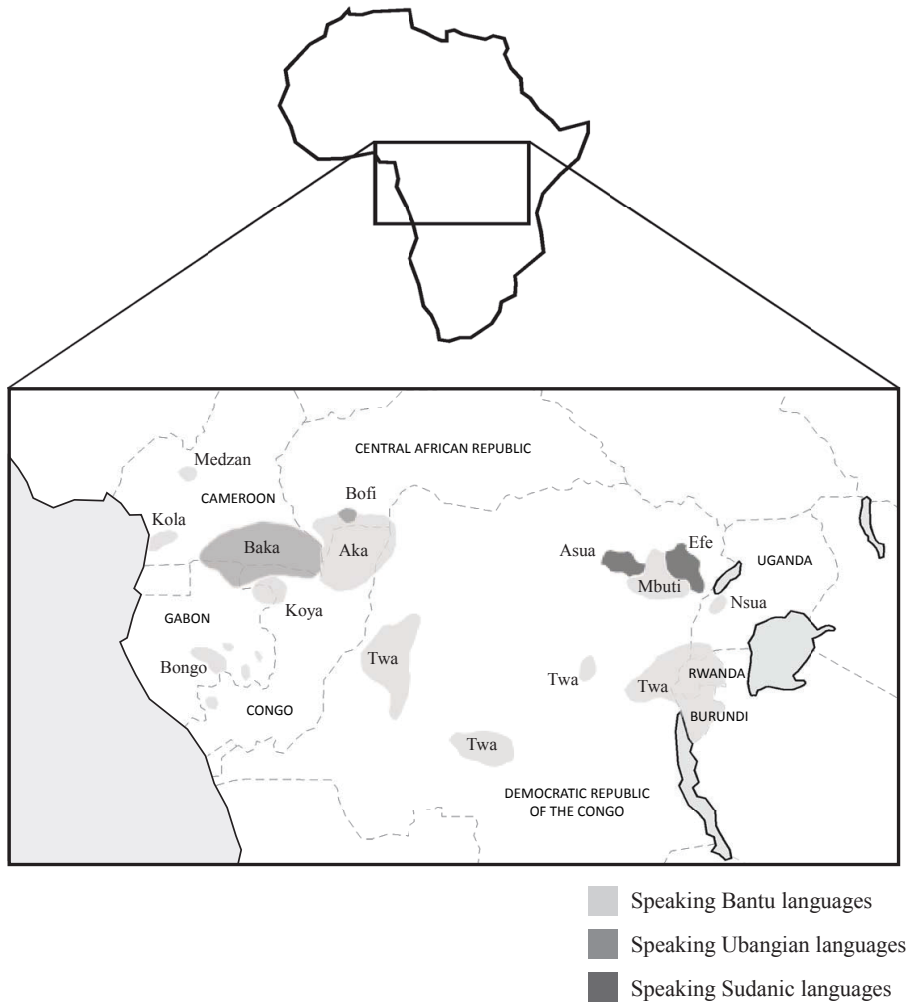
In this paper, I initially compare the duiker species caught by different groups of Pygmies and examine the duiker species inhabiting areas in which different hunting methods are practiced. Then, I examine the relationships between the two factors, arguing that different faunal compositions are among the major contributors to diversity in the hunting methods used by Pygmies. Next, I discuss several implications of this argument, including the need to understand the ecological background in which hunting methods are selected, to design effective wildlife management strategies that are acceptable by the local people who depend on hunting for their livelihood.

## DIVERSITY IN HUNTING METHODS AMONG PYGMIES

First, I will review several arguments concerning the choice of hunting methods by the Pygmies (also see Hewlett, 1996), underscoring that previous studies have neglected the differences in the species of duiker species caught with different hunting methods.

Harako (1976) emphasized that the Mbuti were not legendary “elephant hunters”<sup>(1)</sup> but were “duiker hunters.” Although the image that the smallest people hunt the largest terrestrial animals stimulates our imagination, it is clear that duikers are the most important game animals consumed by Mbuti in their daily diet. Harako (1976) also examined differences in the methods used by the Mbuti net hunters and the Efe archers, neighbors in the northeastern Congo Basin, emphasizing the similarities in their approaches; namely, the fact that both groups target forest duikers hidden under the thicket, and flush the animals out of hiding. The difference between the two groups is that the Mbuti encircle the target with nets, and the Efe do so with archers. Harako (1976) suggested that like the contemporary Efe, the ancestors of the Mbuti hunted animals with bows and arrows until Bantu-speaking farmers arrived in the area with nets. They may have begun the practice of net hunting at the request of farmers, but they eventually found that net hunting was more efficient than bow-and-arrow hunting. As a result, a division of labor has developed between the Mbuti and the neighboring Bantu; specifically, the former group hunt, and the latter group cultivate, and they exchange their yields with each other. On the other hand, the Efe have enjoyed a close relationship with Sudanic-speaking farmers who have not used nets for hunting. Therefore, the Efe have continued to hunt with bows and arrows, and the division of labor is less pronounced in this case than it is in relation to the Mbuti and the Bantu.

However, the hypotheses proposed by Harako (1976) and others (e.g., Abuzzi, 1979; Milton, 1985) were based on an unexamined assumption; namely, that net hunting is more efficient than bow-and-arrow hunting for obtaining the same amount of meat. This would be true if efficiency were calculated based on the number of hours spent hunting. However, there is no significant difference between



**Fig. 1.** African forest hunter-gatherers, or Pygmies, distributed in and around the Congo Basin (based on Hewlett & Fancher, 2014).

the two approaches when person-hours are treated as the denominator (i.e., 0.11–0.39 kg/person-hour for net hunting and 0.12–0.33 for bow-and-arrow hunting) because net hunting requires many more people, especially women, as beaters (Ichikawa, 1983; Terashima, 1983; Bailey & Aunger, 1989; Wilkie & Curran, 1991).

Bailey and Aunger (1989) argued that hunting methods are chosen in accordance with the division of labor between men and women. In the Mbuti area, meat has a greater sales value, whereas labor is scarce in the Efe area. Therefore, it is more productive for Mbuti women to engage in hunting to

obtain agricultural crops to exchange for meat. In contrast, it is more productive for Efe women to work in the fields of neighboring farmers to obtain crops.<sup>(2)</sup>

However, as noted by Bailey and Aunger (1989) themselves, this hypothesis does not fully address the clear difference between the hunting methods used by the Mbuti and Efe. Indeed, even if women were not available, men could perform net hunting if necessary. The authors argued that this difference resulted from differences in the availability of nets. An average net, which is 60 m long, requires 300 person-hours of labor. Moreover, net hunting itself requires that ten or more people simultaneously prepare nets, which raises questions about how the Mbuti and the Efe began this practice under conditions in which they had no nets at all. This scenario seemed unlikely to Bailey and Aunger (1989), who suggested that they may have obtained nets from neighboring farmers so they could immediately engage in net hunting. Although this argument resembles that of Harako (1976), Bailey and Aunger placed more emphasis on the different roles of hunting in the livelihoods of the two groups.

However, Wilkie and Curran (1991) noted that Bailey and Aunger did not explain why the Mbuti abandoned bows and arrows and adopted nets. They compared the kinds of animals caught by Mbuti net hunters and Efe archers, noting that duikers and chevrotain comprised 92% (73/79) of the total Mbuti captures, and 47% (34/73) of the total Efe captures. As mentioned above, the efficiency of these two methods were comparable; however, net hunting was more effective than bow-and-arrow hunting for small ungulates. Based on this difference, Wilkie and Curran (1991) argued that the adoption of nets by the Mbuti may have been related to the differential value of duiker meat at market, as this meat can be sold at prices 33–100% higher in the Mbuti area. However, this hypothesis is not supported by historical evidence, because both Mbuti men and women practiced net hunting, as they do today, even before a road connected them to the large market (Hewlett, 1996).

Most previous studies have focused on the difference between the Mbuti net hunters and the Efe archers in the northeastern Congo Basin. Insights from this research can be applied to the situation in the northwestern Congo Basin, where the Aka practice net hunting and the Baka do not. This difference also appears to relate to whether neighboring farmers had nets. Although they share many cultural and physical features, the Aka speak a Bantu language,<sup>(3)</sup> whereas the Baka speak an Ubangian language (Bahuchet, 1993). Moreover, many Bantu farmers practice net hunting, whereas few Ubangian-speaking farmers do so (Hewlett, 1996).

Recently, Lupo and Schmitt (2005) compared the post-encounter return rates (kcal/person-hour) of various methods practiced by the Bofi and Aka, and found that net hunting was the least profitable approach, because it required a large labor force and considerable handling time. In addition, the risk to each individual of not having a catch on a given day was the largest (about 90%), although sharing helped to equalize the availability of meat. Nevertheless, net hunting is a predominant method among the Bofi and Aka. Lupo and Schmitt argued that this suggests that net hunting may yield non-consummative benefits that can take many forms, including the enhancement of social relationships, the

establishment of political alliances, the formation of bonds with other hunters, the attraction of mates, or the communication of desirable qualities. They also argued that the opportunity costs associated with net hunting are reduced when many different resource opportunities (e.g., insects, nuts, fruit, honey) are potentially encountered. Furthermore, Lupo (2011) argued that the use of inefficient nets for hunting is an extension of a much older process in which foragers advertised their affiliation with Bantu farmers, who provided access to a variety of attractive benefits.<sup>(4)</sup>

The case of the Baka is more complex. The Baka were traditionally spear hunters (Bahuchet, 1993), but their major hunting method has recently shifted to snare hunting (Yasuoka, 2006a). The Baka speak an Ubangian language, which implies they had had close relationships with Ubangian farmers, most of whom were less eager to participate in net hunting than Bantu farmers. Nevertheless, most contemporary Baka have developed relationships with Bantu farmers, some of whom practiced net hunting (e.g., the Fang in southern Cameroon) (Hewlett, 1996). In addition, an elder Baka at my research site, southeastern Cameroon, learned from his father that neighboring Bantu farmers had practiced net hunting (Yasuoka, 2006a). Thus, it is likely that there were occasions for the Baka to adopt net hunting. In fact, the Baka living in an area along the Sanga River, which forms a border with the Aka territory, practiced net hunting (Verhille, 1949, cited in Bahuchet, 1993). Furthermore, Bahuchet and Guillaume (1979) argued that the Aka in the southwestern region of the Central African Republic (CAR) have been engaging in net hunting since approximately 1925, when the Bantu farmers lent their nets to the Aka to hunt duikers so that the farmers could sell duiker skins to Europe. Nevertheless, this was not the case for the majority of Baka, which is the basis for the question that this paper attempts to answer. Alternatively, it is possible that because the Bantu farmers in southeastern Cameroon were less eager to engage in net hunting, they were reluctant to ask the Baka to do so. If true, why was this the case?

As reviewed in this section, the diversity in the hunting methods used by Pygmies has been explained in terms of the efficiency of labor input, the availability of hunting implements, the roles of hunting in the livelihood of people, and the relationship with neighboring farmers. Although these factors are important, previous studies have ignored the differences in the duiker species caught in areas where different hunting methods were practiced. As discussed in the following sections, this issue is important for developing an understanding of why the former Baka spear hunters did not shift into net hunting, and why snare hunting has become prevalent within this group.

## SNARE HUNTING BY THE BAKA

Baka territory straddles southeastern Cameroon, the northwestern Congo, and northeastern Gabon (Fig. 1), and is covered with a tropical rainforest that sits on gently rolling hills at an altitude of 400–600 m above sea level. Although no recent census of the Baka population is available, the population of southeastern

Cameroon has been estimated at about 30,000 (Njounan Tegomo et al., 2012). Thirteen groups of Bantu farmers and two groups of Ubangian farmers have close social and economic relationships with the Baka (Hewlett, 1996). Since the 1930s, the French-mandated government has promoted the sedentarization of both Baka and farmers, and this policy was continued by the Cameroonian government after independence in 1960 (Althabe, 1965). Since the 1970s, the population has been increasingly concentrated along unpaved highways, and most Baka now live in sedentary settlements located along the roads, although they still spend several months per year in the forest.

An elderly Baka individual, 50–55 years of age, noted that people had formerly constructed snares with plant material, but that the Baka had hunted animals primarily with spears than with snares. Even today, spear hunting is the predominant hunting method when neither steel wires nor firearms are available. Baka men always carry spears when they walk in the forest, and they hunt animals whenever an opportunity arises. The major targets of spear hunting are red river hogs (bushpig, *Potamochoerus porcus*), which reach 50 kg in weight and live in herds. Smaller animals, such as brush-tailed porcupines and mongooses, weighing 2 or 3 kg and that are often hidden under fallen trees, are also hunted with spears and the aid of dogs. Duikers are seldom hunted with spears, because they live singly or in pairs and are difficult to find; however, bay duikers (*C. dorsalis*), which are nocturnal and are often found lying in a resting place, are hunted with spears more frequently than are other duikers.

The elderly Baka individual mentioned above also reported that steel wires became available for use in foot snares during his childhood (1960s), and snares are now the major method of hunting. When an animal steps on a snare, a rod that has been bent springs loose, causing the wire fastened to it to wrap around the animal's foot and pull it up (Fig. 2). Yasuoka (2006b) reported that 91 animals were captured with snares, 11 with spears, 6 with bear hands, 1 with machetes, and 1 with a gun in a period during which 89 Baka spent 2.5 months in the forest. Snare hunting is usually practiced in smaller forest camps containing between one and five households. Snares are usually set 10–30 m apart from each other along animal trails, although sometimes two or three snares are set side by side. Because setting a snare requires 30 min, men set a maximum of about ten snares per day. Hunters visit their snares every 3 days because trapped animals will spoil within a couple of days of death. They search for honey or hunt animals with spears on the other days.

A new wire can be untangled into six finer wires. When the Baka set snares targeting red duikers that weigh about 15–20 kg, they use wires untangled into two pieces, each which contains three finer wires. When they target blue duikers that weigh 4–5 kg, they use individual wires, which are the finest. In areas with more powerful animals, such as bongos, buffaloes, and leopards, they use re-twisted full wires. Thus, one can predict the identity of the target animal based on the thickness of the wires in the snare. During my intensive field research between 2001 and 2005, I observed that semi-full wires, which targeted red duikers, were usually used.

In 2003, snare hunting at five forest campsites built 15–30 km from the





**Fig. 2.** An animal captured in a snare.

village yielded 662 catches composed of 24 species: 11 ungulates, 5 primates, 5 carnivores, 2 rodents, and 1 pangolin (Table 1). Red duikers comprised 73% (486/662) of the total captures: Peter's duikers (*Cephalophus callipygus*) accounted for 83% (403/486), bay duikers (*C. dorsalis*) accounted for 14% (67/486), white-bellied duikers (*C. leucogaster*) accounted for 2.6% (13/486), and black-fronted duikers (*C. nigrifrons*) accounted for 0.6% (3/486). In addition, 43 (6%) red river hogs, 35 (5%) blue duikers (*Philantomba monticola* [syn. *Cephalophus monricola*]), and 34 (5%) yellow-backed duikers (*C. silvicultor*) were captured.

#### CATCH ACCORDING TO HUNTING METHOD

In general, the Pygmies are duiker hunters. However, the species of duiker hunted by the Baka differs substantially from those hunted by the Mbuti. As shown in Table 2, blue duikers accounted for 52–96% of the total yield of the net-hunting activities of the Mbuti in the Ituri Rainforest of northeastern DRC (Harako, 1976; Tanno, 1976; Ichikawa, 1983; Hart, 2000). The same trend was observed regarding the net hunting practiced by the Aka in Motaba and Ibenga in the north region of the Congo (Kitanishi, 1995; Takeuchi, 1995), and in



**Table 1.** Animals snared by the Baka in five forest camps in 2003

English name	Latin name	Baka name <sup>1</sup>	Catch	Class in the hunting regulation <sup>2</sup>
Red duikers			486	
Peter's duiker	<i>Cephalophus callipygus</i>	géndi	(403)	B
Bay duiker	<i>Cephalophus dorsalis</i>	ngbòmù	(67)	B
White-bellied duiker	<i>Cephalophus leucogaster</i>	mòngala / míe	(13)	C
Black-fronted duiker	<i>Cephalophus nigrifrons</i>	mònjumbe	(3)	C
Red river hog	<i>Potamochoerus porcus</i>	pàmè	42	B
Blue duiker	<i>Philantomba monticola</i>	dèngbè	35	C
Yellow-backed duiker	<i>Cephalophus silvicultor</i>	bèmbà	34	A
African golden cat	<i>Felis aurata</i>	ebíe	11	C
Agile mangabey	<i>Cercocebus agilis</i>	tamba	11	A
Western lowland gorilla	<i>Gorilla gorilla gorilla</i>	ʔèbobo	6	A
Chimpanzee	<i>Pan troglodytes</i>	sèkò	5	A
Giant forest hog	<i>Hylochoerus meinertzhageni</i>	bèà	5	B
Leopard	<i>Panthera pardus</i>	súà	5	A
Water chevrotain	<i>Hyemoschus aquaticus</i>	ʔakòlò / gekè	5	A
Giant pangolin	<i>Smutsia gigantea</i>	kelepa	4	A
Brush-tailed porcupine	<i>Atherurus africanus</i>	mbòke	3	C
Marsh mongoose	<i>Atilax paludinosus</i>	nganda	3	C
African forest buffalo	<i>Syncerus caffer nanus</i>	mbòko	1	B
Black-footed mongoose	<i>Bdeogale nigripes</i>	buse	1	C
Giant pouched rat	<i>Cricetomys emini</i>	gbè	1	C
Guereza	<i>Colobus guereza</i>	kàlu	1	A
Honey badger (Ratel)	<i>Mellivora capensis</i>	ebò	1	C
Putty-nosed monkey	<i>Cercopithecus nictitans</i>	kói	1	C
Sitatunga	<i>Tragelaphus speki</i>	mbùli	1	B
Total			662	

This table is based on the same data analyzed by Yasuoka (2006a). For detailed information of the research methods, please see Yasuoka (2006a).

<sup>1</sup>Baka names are written based on Brisson & Boursier (1979).

<sup>2</sup>According to Law No. 94/01 of 20 January 1994 to lay down Forestry, Wildlife and Fisheries Regulations (Government of Cameroon, 1994) and Decree 95/466 of 20 July 1995 to determine the conditions for the implementation of the Wildlife Regulations (Government of Cameroon, 1995), animal species are distributed into three classes of protection (see also Djeukam, 2012). The species of Class A shall be totally protected and may on no occasion be killed except for cases where certain animals constitute a danger or cause damage to persons and/or property, which are comprised of 31 species of mammal, 61 birds, 15 reptiles, and one batrachian. The species of Class B shall be protected and may be hunted, captured or killed subject to the grant of a hunting permit, which are comprised of 20 mammals, 89 birds, and 44 reptiles. The species of Class C shall be partially protected and their capture and killing are regulated in order to maintain the dynamics of their populations, which are comprised of species other than those of Class A and B, and birds of the annexes III of the CITES (Washington Convention).

Dzanga-sangha and N'gotto (including the Bofi) in the southwestern portion of CAR (Noss, 2000; Lupo & Schmitt, 2005). In contrast, red duikers accounted for the majority of snare-hunting captures of the Baka and their neighboring farmers in Boumba-Bek, Nki, and Lobéké in southeastern Cameroon (Fimbel et al., 2000; Hattori, 2012; Table 1).

The data from areas in which both snare and net hunting were practiced suggest that net hunting was more successful in capturing blue duikers. Kitanishi (1995) collected data on both methods, as practiced by a single Aka group in Motaba, Congo. Net hunting yielded 24 captures, 23 (96%) of which were blue duikers, whereas snare hunting yielded 39, 18 (46%) of which were red duikers and only 4 (10%) of which were blue duikers. According to Noss (2000), in Dzanga-sangha, CAR, blue duikers accounted for 75% (440/589) of the total net-hunting catch of the Aka, whereas blue duikers accounted for 38 (31%); red duikers accounted for 47 (36%) of the total of 124 captures achieved by neighboring farmers using snares. In addition, 95% (305/320) of the net-hunting catch of the Bofi and Aka in N'gotto, CAR consisted of blue duikers, whereas merely 9% (5/56) of the catches were blue duikers, and 45% (25/56) were red duikers when snares were used (Lupo & Schmitt, 2005). In Ituri, where the Mbuti practiced small-scale snare hunting, Hart (2000) documented that 29 duikers, 25 of which were red, were captured by this method. These associations between the composition of the catches in the same area and the hunting method used suggest that the targets of net hunting and snare hunting differ considerably; that is, nets target blue duikers, and snares target red duikers.

Anomalies (i.e., the catch of blue duikers exceeded that of red duikers when snares were used) were found at 3 of 13 sites in Cameroon (Lobéké, Ndongo, and Campo). Because all of these sites neighbored areas that were densely populated by humans, the wildlife populations appear to have been affected by continuous hunting pressure. The anomaly in the Lobéké site clearly resulted from this pressure, because there was a higher density of blue duikers 0–10 km from the village (Table 3; Fimbel et al., 2000). Conversely, it appears that a higher density of red duikers was originally found in remote areas in this region (Table 3). It has also been estimated that Hayashi's (2008) research site, Ndongo, was also characterized by a low density of both kinds of duiker, probably because of high hunting pressure (Ndongo-Ajala in Table 3; Ekobo, 1998). Although no estimates of the density of duikers is available for Campo, where Mori (1994) conducted his research, it is likely that this area contained a much lower density of duikers than southeastern Cameroon, because capture was much less efficient (434 snare-nights were needed for a catch; Iwamoto, 1990) than in the Baka area (121 snare-nights were needed for a catch; Yasuoka, 2006a).

These anomalies suggest that a high density of blue duikers relative to that of red duikers can be found in areas under continuous heavy hunting pressure, even when red duikers were originally more abundant. Blue duikers (4–5 kg) are three or four times as small as red duikers (15–20 kg). The behavior of duikers seems to be consistent with the general rule that smaller animals propagate more rapidly (Caughley & Krebs, 1983; van Vliet & Nasi, 2008). Therefore, continuously high levels of hunting pressure have had a major impact on the

**Table 2.** Number of catches and the ratio of blue duikers and red duikers to the hunting harvests of Pygmies or neighboring farmers throughout the Congo Basin

Hunting method	Country	Site	Ethnic group	Blue duiker		Red duikers		Total catch <sup>15</sup>
				Catch	Ratio	Catch	Ratio	
Net	Democratic Republic of the Congo	Ituri <sup>1</sup>	Mbuti	42	78%	11	20%	54
		Ituri <sup>2</sup>		66	52%	39	31%	126
		Ituri <sup>3</sup>		98	69%	25	18%	142
		Ituri, south, settled area <sup>4</sup>		356	77%	107	23%	* <sup>16</sup>
		Ituri, south, remote area <sup>4</sup>		1,054	76%	335	24%	* <sup>16</sup>
		Ituri, central, settled area <sup>4</sup>		698	70%	303	30%	* <sup>16</sup>
		Ituri, central, remote area <sup>4</sup>		974	68%	465	32%	* <sup>16</sup>
	Congo	Motaba <sup>5</sup>	Aka	23	96%	1	4%	24
		Ibenga <sup>6</sup>		112	69%	46	28%	162
	Central African Republic	Dzanga-sangha <sup>7</sup>	Aka/Bofi	440	75%	64	11%	589
		N'gotto <sup>8</sup>		305	95%	9	3%	320
Snare	DRC	Ituri, south <sup>4</sup>	Mbuti	4	* <sup>17</sup>	25	* <sup>17</sup>	* <sup>17</sup>
	CAR	Dzanga-sangha <sup>7</sup>	Farmers	38	31%	47	36%	124
		N'gotto <sup>8</sup>	Bofi/Aka	5	9%	25	45%	56
	Congo	Motaba <sup>5</sup>	Aka	4	10%	18	46%	39
	Cameroon	Nki <sup>9</sup>	Baka	35	5%	486	73%	662
		Boumba-Bek <sup>10</sup>		24	10%	135	59%	229
		Ndongo <sup>11</sup>		48	40%	45	38%	120
		Lobéké (0–10 km) <sup>12</sup>		245	37%	113	17%	667
		Lobéké (10–20 km) <sup>12</sup>	Baka/Bangando (farmer)	55	27%	82	40%	206
		Lobéké (20–30 km) <sup>12</sup>		22	17%	85	65%	131
		Lobéké (30 < km) <sup>12</sup>		3	15%	16	80%	20
		Campo <sup>13</sup>	Bai (farmer)	14	38%	16	43%	37
		Campo <sup>14</sup>	Bai (farmer)	60	47%	29	23%	127

Colored cells indicate superiority over the homologues. <sup>1</sup>Harako (1976). <sup>2</sup>Tanno (1976). <sup>3</sup>Ichikawa (1983). <sup>4</sup>Hart (2000). <sup>5</sup>Kitanishi (1995). <sup>6</sup>Takeuchi (1995). <sup>7</sup>Noss (2000). <sup>8</sup>Lupo & Shmitte (2005). <sup>9</sup>Table 1. <sup>10</sup>Hattori (2012). <sup>11</sup>Hayashi (2008). <sup>12</sup>Fimbel et al. (2000). <sup>13</sup>Iwamoto (1990). <sup>14</sup>Mori (1994). <sup>15</sup>Total captures include all hunted animals other than duikers. <sup>16</sup>Hart's (2000) data were derived from estimates of the number of catches in annual harvests rather than from observations, and no information about total catches was provided. <sup>17</sup>Hart (2000) mentioned only duiker catches, and the proportion of the total catches accounted for by duikers remains unknown.

**Table 3.** Estimated density of blue duikers and red duikers in areas in which Pygmy populations practice hunting

Country	Site	Pygmy population around the site	Surveyed extent from the nearest villages (km)	Density (individuals/km <sup>2</sup> )	
				Blue duiker	Red duikers
Democratic Republic of the Congo	Ituri, south, settled area <sup>1</sup>	Mbuti	0–10	6.9	2.2
	Ituri, south, remote area <sup>1</sup>		0–20	11.7	3.9
	Ituri, central, settled area <sup>1</sup>		0–10	14.8	8.2
	Ituri, central, remote area <sup>1</sup>		10–20	17.8	8.7
	Ituri, central, no hunting area <sup>1</sup>		15	10.2	10.7
	Ituri, central, no hunting area <sup>1</sup>		20	20.6	21.2
	Ituri, central <sup>2</sup>		a few	13.6	7.0
	Ituri, central <sup>2</sup>		10	11.2	5.9
	Ituri, northeast, regrowth <sup>3</sup>	Efe	0–2	69	55
	Ituri, northeast, mature forest <sup>3</sup>		4–6	61	74
Central African Republic	Dzanga-Sangha <sup>4</sup>	Aka	0–5	10.7	2.7
			5–10	14.8	2.4
			10–15	20.4	3.0
Gabon	Makogou, hunting area <sup>5</sup>	non		30.4	3.4
	Makogou, no hunting area <sup>5</sup>			53.0	12.5
Cameroon	Lobéké <sup>6</sup>	Baka	0–10	3.6	2.5
			10–20	2.3	5.5
			20–30	1.4	6.3
			30 <	3.8	15.1
	Lobéké <sup>7</sup>		30 <	3.1	11.0
	Boumba-Bek <sup>8</sup>		10–50	3.7	11.0
	Boumba-Bek <sup>9</sup>		10–50	10.6	11.2
	Nki <sup>8</sup>		10–50	0.1	6.0
	Nki <sup>10</sup>		5–50	2.8	6.8
	Corridor <sup>8</sup>		5–40	0.4	5.3
	Corridor <sup>11</sup>		10–30	0.6	8.0
	North Nki <sup>8</sup>		0–30	2.3	10.0
	Moloundou <sup>8</sup>		5–20	1.4	1.3
	Ndongo-Ajala <sup>8</sup>		5–20	0.0	0.8
	Ngoila <sup>8</sup>		5–40	7.4	20.0
	CHZ 13 <sup>12</sup>		0–30	1.6	2.3
	CHZ 14 <sup>12</sup>		0–20	4.9	7.2

Colored cells indicate superiority over the homologues. <sup>1</sup>Hart (2000). <sup>2</sup>Koster & Hart (1988). <sup>3</sup>Wilkie & Finn (1990). <sup>4</sup>Noss (2000). <sup>5</sup>Lahm (2001). <sup>6</sup>Fimbel et al. (2000). <sup>7</sup>Nzooh Dongmo (2003). <sup>8</sup>Ekobo (1998), corridor forest is included in Nki National Park. <sup>9</sup>Bene Bene & Nzooh Dongmo (2005). <sup>10</sup>Nzooh Dongmo et al. (2006). <sup>11</sup>Yasuoka (2006a). <sup>12</sup>Bobo et al. (2014), CHZ is an abbreviation for Community Hunting Zone.

density of red duikers, leading the relative density of blue duikers to increase.

## DUIKER SPECIES IN LOCAL FAUNAS

Table 3 shows the density of blue and red duikers in various sites throughout the Congo Basin. These estimates should be interpreted with caution, because variations in ecological conditions and/or survey methods can have a substantial effect on data from the same region. For example, in the Ituri Rainforest of the DRC, the density of blue duiker ranges between 6.9 and 69 individuals/km<sup>2</sup>, and that of red duikers ranges between 2.2 and 74 (Koster & Hart, 1988; Wilkie & Finn, 1990; Hart, 2000). It is therefore unclear whether these values represent the approximate actual densities of the sites or represent over/underestimates.

Nevertheless, there are differences between the sites in Cameroon and those elsewhere regarding the ratio of blue to red duikers. Indeed, the density of red duikers exceeded that of the blue duiker in 15 of the 17 sites in southeastern Cameroon. In contrast, the density of blue duikers exceeded that of red duikers in 7 out of 10 sites in Ituri, DRC; this was also the case in all three sites in Dzanga-sangha, CAR and in the two sites in Makogou, Gabon. Furthermore, compared to the comparable data from other regions, the ratio of blue to red duikers in the Cameroon sites was very low in terms of both absolute and relative values.

As mentioned above, Ituri is the primary area in which the Mbuti practice net hunting, and Dzanga-sangha is one of the primary areas in which the Ada do so. In contrast, in southeastern Cameroon, the Baka engage primarily in snare hunting. Thus, it appears that net hunting is used as the predominant method of capture in areas with a high density of blue duikers, and that snare hunting is most common in areas containing more red duikers.

Finally, it should be noted that the density of red duikers was comparable to or exceeded that of blue duikers in three sites in Ituri (Wilkie & Finn, 1990; Hart, 2000). This is certainly related to the fact that these results were obtained from regions in which net hunting was not practiced. Although the validity of these very large values should not be taken at face value, we can assume that the density of red duikers was originally comparable to that of blue duikers. If so, the density of red duikers in hunting areas was two or three times lower than that of blue duikers in these areas (Hart, 2000). Thus, it appears that net hunting had a more powerful effect on red duikers, leading to the disappearance and/or escape of the majority of the red duiker population from the hunting areas.

Noss (2000) reported that the rate at which blue duikers escaped from nets was 41%, whereas the rate for red duikers was 56–61%. Red duikers are three or four times as heavy as blue duikers, rendering them more powerful and better able to escape from nets. In other words, once enclosed by nets, a blue duiker is more likely to be captured than is a red duiker. However, red duikers appear to be more vulnerable at level of the local population. This is probably due to their slower propagation compared to blue duikers as well as their larger home range, which facilitates their migration from the hunting area. In contrast,

blue duikers appear to have the superior ability to increase in number even when they are hunted. Therefore, it is likely that continuous net hunting has changed the local composition of duiker species in a direction that favors net hunting.

## DISCUSSION

### I. Why Are Snares Rather than Nets Used in Southeastern Cameroon?

The density of blue duikers is higher in the area in which the Mbuti practice net hunting that targets blue duikers, whereas the density of red duikers is higher in the area in which the Baka practice snare hunting that targets red duikers. Thus, the Mbuti are “blue duiker hunters,” and the Baka are “red duiker hunters.”

Many researchers have noted that net hunting is suitable for capturing smaller animals with smaller home ranges that are distributed rather evenly in the forest (e.g., Hart, 2000; Noss, 2000; Lupo & Schmitt, 2005). Blue duikers are reluctant to leave their small home range and conceal themselves in thick undergrowth when threatened. However, Peter’s duikers, one of the major types of red duikers, are active by day, inhabit a larger home range than do blue duikers, and are more likely to flee from approaching net hunters<sup>(5)</sup> (Noss, 2000).

In contrast, snares are more appropriate for capturing animals who move over larger ranges, as the only thing that snare hunters can do is wait for animals to activate the snares. Animals who cover larger areas encounter more snares. If one area contains a certain number of blue duikers and another area contains the same number of Peter’s duikers, the catch from the latter area will exceed that from the former area when the same numbers of snares are set. Therefore, snares can catch more animals in the Baka area, and nets can catch more animals in the Mbuti area. These facts seem to have influenced the selection of hunting methods. Moreover, the available records about meat harvests appear to demonstrate that these choices were reasonable. The Mbuti obtained an average of 0.58 kg meat for daily consumption by adults via net hunting (Ichikawa, 1983), and the Baka acquired 0.39 kg meat via snare hunting (Yasuoka, 2006b). Both amounts of meat provide sufficient protein.<sup>(6)</sup>

Other than the targets, the important difference between the two methods is that net hunting is quite time-consuming and labor-intensive. Lupo and Schmitt (2005) estimated the efficiency of the different hunting methods employed by the Bofi and Aka in N’gotto, CAR using the post-encounter return rate, which is calculated from the amount of harvest divided by the total handling time by all participants after encounters with targets, regardless of outcome. As expected, the post-encounter return rate for net hunting was much lower (106–215 kcal/person-hour) than that for snare hunting (4,909 kcal/person-hour) and spear hunting (2,152–6,769 kcal/person-hour). This is obviously because net hunting was practiced by a larger number of participants, including women and children. In contrast, snare hunting is individual-based and does not require much labor after the installation of snares.



If the post-encounter return rate was sufficiently important, no one would adopt net hunting as a principal method. However, the Mbuti, the Bofi, and the Aka use it as their primary method. It is not surprising that the post-encounter return rate is not the major contributor to decisions by hunter-gatherers, whose time and labor are not scarce, about their approach to hunting. In this context, the availability of a sufficient and stable supply of meat appears to be more important. In fact, the harvests from net hunting on a given day were sufficient for the participants and their families (Ichikawa, 1983).

However, if the density of blue duikers was significantly lower, net hunting would no longer be profitable. The data presented in Table 3 show that this was the case in southeastern Cameroon, although the reason for the much lower density of blue duikers in this region remains unknown.

The composition of duiker species probably affected the hunting methods used by neighboring farmers. It is very likely that farmers in southeastern Cameroon were reluctant to practice net hunting and/or to lend nets to the Baka even when nets were available. Alternatively, they probably practiced snare hunting as their primary method. As argued by Sato (1983) and Takeda (1996), farmers have depended on a variety of snares to capture animals, because farmers are confined to certain areas and rely on considerable labor for cultivation. The choice of hunting methods by the Baka must have been influenced by their neighboring farmers.

## II. Why Does Traditional Baka Hunting Involve Spears Rather than Nets?

Before steel wires became available to the Baka, they hunted animals with spears. As mentioned above, spear hunting is much more profitable than net hunting in terms of the post-encounter return rate (Lupo & Schmitt, 2005). However, if the targets are limited to small duikers, spear hunting is probably less feasible than net hunting, in which more stable encounters are secured through flushing out the animals hiding near the nets. Therefore, spear hunting for small duikers may provide less meat on a given day, even when it is efficient once the hunters encounter the targets. Thus, spear hunting that targets small animals (duikers, brush-tailed porcupines, and mongooses) is often practiced during net hunting (Lupo & Schmitt, 2005), and other activities (e.g., searching for honey, gathering fruits, traveling to forest camps, and net hunting).

However, another type of spear hunting practiced by the Baka involves hunting groups of between five and ten men searching for prey for 1 or 2 weeks. Currently, collective hunting expeditions primarily target elephants, and a gun is provided by neighboring farmers (Yasuoka, 2013). Nonetheless, the primary purpose of these expeditions does not prevent participants from practicing other activities along the way. Indeed, only one hunter per group carries a gun, and the others carry spears to hunt red river hogs, which are frequently encountered during these expeditions. It is likely that groups engaged in this type of hunting expedition used only spears before guns became available. Even today, when an elephant hunt ends in failure, it will be said that the expedition was, in fact, organized to hunt hogs and gather honey.

The Baka have a peculiar taboo concerning elephants and red river hogs: both the man who delivers the first spear or gunshot to these animals and his elderly relatives are prohibited from eating the hunted animal's meat (Yasuoka, 2013). It is thought that breaking this taboo will prevent the hunter from successfully killing elephants and hogs in the future. The common feature shared by these two species is their status as targets of collective spear hunting. Elephants are the largest animal hunted with spears, and hogs are the animals most frequently hunted using this method. Thus, it can be assumed that collective spear hunting has a deep connection with the Baka culture. Historically, the Baka were not "red duiker hunters"; instead, they were "hog hunters." Hogs are larger than red duikers, live in herds, and move around a much larger range.

The fact that the Baka did not shift from spears to nets suggests that sufficient hogs were available to the Baka. Although information about the density of red river hogs is unavailable in most areas (see Hart, 2001; Lahm, 2001), the extant hunting records suggest that the availability of hogs in southeastern Cameroon exceeded that in other regions. As shown in Table 1, red river hogs comprised 6.3% (42/662) of the total snare captures southeastern Cameroon, whereas they accounted for 1.9% (2/105) of the total snare captures in Dzanga-sangha, and none (0/56) of the total snare captures in N'gotto, CAR (Noss, 2000; Lupo & Schmitt, 2005).

Kitanishi (1995), who conducted research in Motaba in the northern Congo, provided interesting data about Aka hunting practices. Unlike their practices at other sites, where the Aka primarily practiced net hunting, the Aka in Motaba often used snares and spears. During the period of his research, they captured 39 animals with snares (equivalent to 1,049 kg), including 18 red duikers and 5 hogs; 24 with nets (119 kg), including 23 blue duikers; and 5 hogs (180 kg) with spears (Kitanishi, 1995). In this area, the proportion of hogs caught with snares, 13% (5/39), exceeded that in the Baka area, and as the case of the Baka the hogs were hunted primarily with spears in Motaba.

These data regarding catches may not fully represent the actual density of these species, but it is notable that the Baka and Aka are apparently eager to practice spear hunting, and that net hunting is absent or less important in areas where many red river hogs are captured with snares. This is predictable based on a simple optimal foraging model. If encounters with more valuable targets are sufficiently frequent, less valuable targets are often ignored. Furthermore, if capturing less valuable targets requires a long time and intensive labor, it is almost impossible to adopt more elaborate hunting methods as the primary approach. If red river hogs were abundant in southeastern Cameroon in general, it would be quite reasonable for the Baka to choose spears to target them even if nets were available.

### III. Why Shift from Spears to Snares?

Hunting is not an independent activity that exists separately from other livelihood-related pursuits. Indeed, all types of hunting are accompanied by efforts to acquire a variety of food resources. Therefore, it is important to

determine whether the targets of hunting and those of other efforts to obtain food (e.g., insects, nuts, fruit, honey) overlap temporally and spatially (Lupo & Schmitt, 2005). For example, both net hunting and collective spear hunting can include these activities. However, these two hunting methods are not compatible with each other, because both are time-consuming and labor-intensive, and because spear-hunting parties must move around in a much larger range to search for signs of targets.

On the other hand, there are minor trade-offs between collective spear hunting and snare hunting. The Baka remain at forest campsites for a couple of months, during which the efficiency of snare hunting does not decline (Yasuoka, 2006a; 2006b). Unlike net hunting, snare hunting does not require intensive labor after the initial installation of snares. Once these are set, hunters inspect the snares only every 3 days. When they encounter signs of hogs while inspecting snares, they can leave the snares to track the animals. More importantly, men can devote days to spear-hunting expeditions, because their wives and children can check the snares.

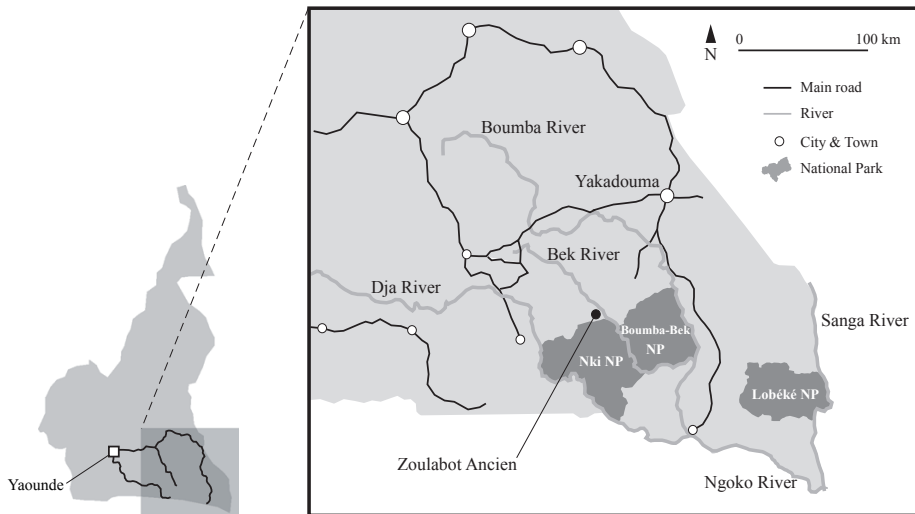
Snare hunting is also compatible with other contemporary livelihood-related activities of the Baka. Currently, the Baka diet depends considerably on agricultural crops that they cultivate themselves (Yasuoka, 2012). Snare hunting was originally developed for an agricultural lifestyle, which obliges people to remain in a certain area (Sato, 1983; Takeda, 1996). In addition, the Baka often spend a couple of months in a forest area with an abundance of wild yams or bush mango (*Irvingia gabonensis*) (Yasuoka, 2006b; 2012). During such long camps in the forest, snare hunting is also possible.

It is likely that the previous use of cords made of plant materials for snares by neighboring farmers was not appealing to the Baka. However, conditions changed after the introduction of steel wires, which have significantly improved the efficiency of snaring. Indeed, a wire that is thick enough can capture not only red duikers, but also red river hogs and larger animals.<sup>(7)</sup> Thus, the adoption of snare hunting did not reduce the Baka's opportunities to harvest. In fact, it has doubled such opportunities.

#### IV. Implications for Wildlife Management in Southeastern Cameroon

Wild animals and bushmeat have been important protein and income sources for residents of the African tropical rainforest, where the availability of livestock is limited. However, both extinction and the declining food supply threaten the livelihoods of these people, and renders the bushmeat trade a national and global concern (Wilkie & Carpenter, 1999; Bennett et al., 2007; Davies & Brown, 2007). In southeastern Cameroon, access to inner forest areas became much easier for bushmeat traders and poachers after extension of the logging road network in the 1990s. The Baka, whose abilities to work in the forest are well developed, were immediately involved in the bushmeat trade network in job roles such as hunters or guides for poachers.

Unlike net or spear hunting, which require a long time and an intensive commitment of labor, snare hunting is limited primarily by the availability



**Fig. 3.** Southeastern Cameroon. In addition to the main roadways described, many secondary roads have been built. Moreover, logging roads have been constructed and maintained by logging companies.

of wire. When the Baka have rolls of wires, the prevalence of snare hunting immediately increases. As in many regions in Central and West Africa (Bennett et al., 2007), there are no conventional institutions to control the expansion of bushmeat hunting and trading in southeastern Cameroon. At my research site, Zoulabot Ancien in the northern periphery of Nki National Park (Fig. 3), the annual bushmeat harvest has increased by a factor of 5–10 compared to the harvest before the logging road was opened, and the extractions have been concentrated in a narrower area (Yasuoka, 2006a). However, this boom in the bushmeat trade decreased to some extent after control over the transport of bushmeat was strengthened in the mid-2000s.

Parallel to the expansion of the commercial logging industry, a wildlife management project has been promoted in southeastern Cameroon, and three national parks (Lobéké, Boumba-Bek, and Nki NPs) were established in the 2000s. However, it has not been easy to incorporate the livelihood-related needs of local peoples in the management plan for this project. For instance, the Baka were not sufficiently included in the zoning process (Njounan Tegomo et al., 2012). Therefore, the wildlife management regulations are too restrictive to allow the local people to continue depending on a variety of forest resources for their livelihood.

According to the forestry, wildlife, and fisheries regulations (Government of Cameroon, 1994; 1995), hunting by local people is prohibited in protected areas; these include the property of third parties, which in turn, include considerable land allocated to commercial companies that provide opportunities for trophy hunting. Furthermore, even outside of these areas, unrestricted hunting is

permitted only under the following conditions: (1) it must only target species in Class C, including blue duikers, black-fronted duikers, some rodents, and some small carnivores, but excluding Peter's duikers, bay duikers, yellow-backed duikers, and red river hogs (Table 1); (2) it must solely rely on "traditional" implements; and (3) it must only be used for household consumption. The law defines "traditional" implements as those made of plant materials, which excludes steel wires. Although spearheads are made of metal, it seems that spears are recognized as "traditional" implements at the local level. In fact, in narrow areas, people are restricted to using spears to hunt blue duikers, brush-tailed porcupines, and cane rats.

Of these three conditions, only (3) may be practical, and only then if other Non-Timber Forest Products can substitute for bushmeat as a source of income. However, (1) and (2) seem problematic. As shown in Table 1, species in Class C account for only 11% (72/662) of total captures. If this regulation is enforced, it is likely that local people will not even be able to obtain the minimum level of protein. In addition, how can species in Class C be hunted? Is it time to practice net hunting? As argued in this paper, approaches to hunting emerge from context and history, including interactions between people and wild animals, the changing role of hunting in the livelihood of people, changes in the availability of implements, the development of economic and social relationships with neighboring populations, and of course, involvement with the expanding bushmeat trade networks. In other words, the abrupt enforcement of a restriction on the use of the principal hunting implements will adversely affect activities that share a common history and context; this will certainly make earning a livelihood more difficult.

As noted by Bennett et al. (2007), whether the issue of bushmeat hunting is primarily one of biodiversity conservation or the livelihood of the local people, or both, varies according to perspective, place, and time. In southeastern Cameroon, it is time to consider bushmeat hunting as primarily a livelihood issue. Even if the hunting methods employed are not "traditional," hunting does not necessarily lead to the depletion of game animals when this practice is limited to the goal of household consumption (Hart, 2000; Yasuoka, 2006a).

It is true that snare hunting can more seriously deplete the populations of species that are scarce and breed slowly (i.e., gorillas, chimpanzees, leopards, bongos). As shown in Table 1, the total of 662 animals snared by the Baka included 6 gorillas, 5 chimpanzees, and 5 leopards, each of which represented about 1% of the total catch. The extent to which this figure is acceptable depends on the total number of captures, and the area from which the animals were extracted. According to my observations and analyses, 150 inhabitants require 630 red duikers per year for household consumption (Yasuoka, 2006a). These inhabitants hunt within a 1,000 km<sup>2</sup> area, including a part of the Park, and the extractions were within the sustainable range (Yasuoka, 2006a). A harvest including this number of red duikers contains seven of each of the aforementioned vulnerable species. The acceptability of this number remains debatable.

Because my research was conducted in an area with a very low-density human population, this argument may not be fully applicable to other areas,

even within southeastern Cameroon. However, an effective wildlife management plan that is acceptable to the local people who depend on hunting for their livelihood must include hunting regulations that are adapted to the local conditions, not vice versa. Certainly, snare hunting can be easily expanded if wires are not prohibited. Thus, it is important to restrict the uncontrolled expansion of bushmeat trading, as this practice will lead to the depletion of wildlife. However, it is also crucial to appreciate the present hunting practices of the local people, recognizing that there are a variety of reasons for these choices. Therefore, I strongly recommend that the use of snares to hunt duikers for household consumption be legalized at least at the periphery of national parks. At that point, we will be able to consider, in collaboration with local people, how to reduce damage to rare species.

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#### NOTES

- (1) According to Harako (1976), spear hunting occupied a unique position among the Mbuti. Although few hunters were successful, a large animal hunted with a spear provided a large quantity of meat for all members of a camp.
- (2) The different value systems of the two areas were the result of differences in the accessibility of densely populated areas (Bailey & Aunger, 1989). Because Mbuti villages were not very distant from densely populated areas, they were visited frequently by merchants, which increased the price of meat. In addition, neighboring farmers had a variety of sources of cash income other than agricultural crops, and were therefore less reliant on Mbuti for labor. On the other hand, Efe villages were so remote from densely populated areas that merchants visited less frequently. Therefore, neighboring farmers tended to cultivate fields that were as large as possible, rendering them much more dependent on Pygmy labor.
- (3) The Bongo in Gabon and the Kola in southern Cameroon are both Bantu-speaking Pygmies, and both used nets (Hewlett, 1996).
- (4) Takeuchi (1995) argued that the economic relationship between the Aka and their farmer neighbors was not as well established as that between the Mbuti and their farmer neighbors. Thus, Aka women needed to work more than did Mbuti women to obtain sources of calories. Because of this limitation on the availability of women for hunting, Aka women could not be solely devoted to net hunting. It was partially for this reason that snare hunting, which can be practiced solely by men, was introduced.
- (5) Therefore, the net-hunting census method may underestimate the density of red duikers (Noss, 1999).
- (6) Robinson and Bennett (2000) estimated that it is necessary to consume 0.28 kg meat per day if protein intake depends solely on animal meat.
- (7) According to Noss (2000), 35% of red duikers that are caught in a snare escaped, whereas 7% of blue duikers did so. However, the ability of an animal to escape depends on the robustness of the snare, especially the thickness of the wire. Judging from the photograph in Noss (2000), people in Dzanga-sangha used wires that are finer than those used for red duikers in southeastern Cameroon.



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